

SUPPORT FOR THE AMENDMENTS

Support for the amendment of Claim 4 is found in original Claim 1.

No new matter will be added to this application by entry of this application.

Upon entry of this amendment, Claims 1-15 are active. Claims 1-3 and 9 are withdrawn.

REQUEST FOR RECONSIDERATION

The claimed invention is directed to a method for the direct preparation of a pure ultra-fine SiO_x powder. Such powders are conventionally made by methods involving a special purification treatment in order to obtain high purity. High purity SiO_x powders are used for an interlayer film of a semiconductor, a gas barrier film on food packaging and protective films for optical components. A method which directly prepares SiO_x powder of high purity in one step is sought.

The claimed invention addresses this problem by providing a method for producing a powder represented by the formula SiO_x wherein x is from 0.6 to 1.8 and the powder has a specific surface area of at least $10 \text{ m}^2/\text{g}$ and a total content of Na, Fe, Al and Cl of at most 10 ppm which comprises reacting monosilane gas with a gas capable of oxidizing the monosilane gas in a non-oxidizing gas atmosphere under a pressure of from 10 to 1000 kPa at a temperature of from 500 to 1000°C , wherein in the reacting, the gas capable of oxidizing the monosilane gas is supplied to a high temperature part of a reactor without prior mixing with the monosilane gas, and the temperature of 500 to 1000°C is obtained by heating the reactor on its periphery. No such method is disclosed or suggested by the cited references.

Applicants wish to thank Examiner Liao and Supervisory Examiner Kim for the courteous and helpful discussion of this application with Applicants' U.S. representative on

July 30, 2008. At that time, Applicants' U.S. representative reviewed the description of the cited references and specifically pointed out that Kumar describes reaction temperature significantly different from the temperature range of the claimed invention. In addition, Applicants' U.S. representative described that the reaction time and technology described by Bergonzo was not compatible with the process of Kumar, and therefore, the two references cannot be combined. The following reiterates and expands upon that discussion.

Applicants respectfully note that Claim 4 is herein amended to be in independent form and to include description of the SiO_x powder from Claim 1.

The rejection of Claims 4-8 and 10-15 under 35 U.S.C. 103(a) over Kumar et al. (U.S. 6,726,990) in view of Bergonzo et al. (ELECTRONICS LETTERS; 31st March 1994, Vol. 30, No. 7)) is respectfully traversed.

The combined references neither disclose nor suggest the method according to Claim 4 of the presently claimed invention.

Kumar describes a method for producing silicon oxide nanoparticles involving laser pyrolysis and subsequently heating the particles produced by the laser pyrolysis under an oxidizing atmosphere at a temperature from about 400 to 800°C for a sufficient period of time to decolorize the particles (Col. 1, lines 49-54). According to the Kumar method, the silicon precursor is a compound with reasonable vapor pressure such as, for example, silicon tetrachloride, trichlorosilane, trichloro methylsilane and tetraethoxysilane (Col. 3, lines 31-40).

According to the Kumar laser method the combined gases are supplied in a well mixed state to a reaction chamber in a molecular stream (Col. 4, lines 8-9). A laser beam intersects the molecular stream and the radiation absorber absorbs the energy and distributes it to the reactants (Col. 3, lines 53-56). Kumar describes the reaction zone as follows:

“Heating of the reaction gases in reaction zone 224 is extremely rapid, roughly on the order of **10^5 degree C/sec** depending on the specific conditions. The reaction is rapidly quenched upon leaving reaction zone 224, and particles 228 are formed in the molecular stream. The nonequilibrium nature of the process allows for the production of nanoparticles with a highly uniform size distribution and structural homogeneity.” (Col. 5, lines 36-43)(Bold added)

Kumar is silent with respect to residence time of the gas mixture in the reaction zone. However, Applicants respectfully submit that at the heating rate described, a residence time of one tenth of a second would lead to a reaction temperature of 1000°C and longer time would result in temperatures significantly higher.

The molecular stream exits the reaction chamber and passes to a collection chamber. The reference clearly indicates that the particles formed in the laser beam are not of high purity and that the particles, **following proper heat treatment** can have a purity of at least 99.9 percent by weight silicon oxide (Col. 9, lines 40-42). Kumar explains the necessity of the purification treatment in Col. 12, lines 32-39 as:

“The stoichiometry of the particles was not determined directly. The particles had a dark color upon visual inspection. The darkness may have been the result of oxygen deficiencies relative to silicon dioxide or to deposits on the particles of elemental carbon from the ethylene in the reactant stream. **The dark color was eliminated upon heating in an oxygen environment in an oven . . .**”(Bold added).

The Office has acknowledged that Kumar is deficient in teaching SiH_4 as a Si source. Bergonzo is cited to show SiH_4 as a precursor gas.

Bergonzo describes a method for the photo-deposition of **silicon dioxide thin films** using silane and oxygen mixtures. This reference **does not describe a partial oxide of formula SiO_x where x is 0.6 to 1.8** and it describes reaction times to form a thin film up to **ten minutes** (p. 607). Moreover, Bergonzo describes that the surface temperature of the substrate upon which the thin film is formed was not increased by the lamp intensity (p. 607).

Applicants submit that 1) Kumar is directed to production of a SiO_x ($1 \leq x \leq 2$), Bergonzo is directed to SiO_2 ; 2) Kumar is directed to reaction times measured in seconds or fractions of seconds, Bergonzo is directed to reaction times on the order of minutes; 3) Kumar is directed to production of nanoparticles, Bergonzo is directed to producing a thin film; 4) Kumar requires an infrared absorber in the reaction gas mixture, Bergonzo does not; and finally 5) Kumar describes reaction temperatures of 1000°C and higher while Bergonzo describes a maximum temperature of 500°C .

Accordingly, Applicants respectfully submit that on the basis of the above differences, an obviousness rejection based on the simple substitution of silane from the description of Bergonzo for the silicon precursors of higher oxidation state (Col. 3, lines 37-40) described by Kumar cannot be supported. The MPEP § 2143 B. states:

“To reject a claim based on this rationale, Office personnel must resolve the Graham factual inquiries. Then, Office personnel must articulate the following: (3) a finding that one of ordinary skill in the art could have substituted one known element for another, and the results of the substitution would have been predictable.”

The Examiner alleges that it would have been obvious to one of ordinary skill in the art to combine the cited references to arrive at the claimed invention. However, the Examiner has not explained how or why the description of the cited references, which teach opposing elements, as described above, would have led a person having ordinary skill in the art to the subject matter claimed.

In view of the foregoing, Applicants respectfully request that the rejection of Claims 4-8 and 10-15 under 35 U.S.C. 103(a) over Kumar et al. in view of Bergonzo be withdrawn.

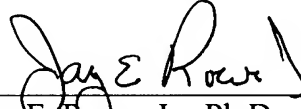
The objection to Claims 4-8 and 10-15 is obviated by appropriate amendment. Claim 4 is herein written in independent form, including the description of Claim 1.

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Applicants respectfully submit that the above-identified application is now in
condition for allowance and early notice of such action is earnestly solicited.

Respectfully submitted,

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